

# PATENT ABSTRACTS OF JAPAN

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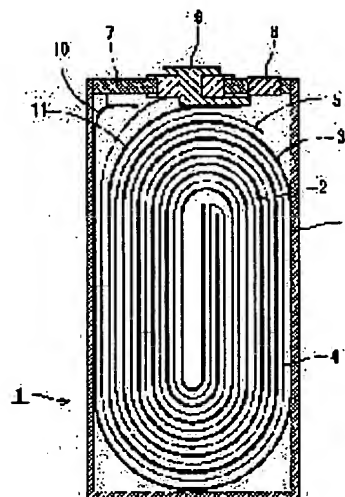
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## (54) NONAQUEOUS SECONDARY BATTERY

### (57)Abstract:

**PROBLEM TO BE SOLVED:** To provide a nonaqueous secondary battery having superior high- temperature shelf life.

**SOLUTION:** The nonaqueous secondary battery 1 comprises a nonaqueous electrolyte containing at least one type selected from a sultone compound, cyclic sulfate, and vinylene carbonate and at least one type selected from an alkyl benzené derivative having tertiary carbon neighboring phenyl groups, a cycloalkyl benzene derivative, and a biphenyl derivative, whereby coatings are formed on a positive electrode 3 and a negative electrode 4. The coatings suppress the high-temperature decomposition of the electrolyte, resulting in improved high-temperature shelf life.



1: 電池  
2: 電解質  
3: 正極  
4: 負極  
5: 電極被覆層  
6: 電解質被覆層  
7: 電解質被覆層  
8: 電解質被覆層  
9: 電解質被覆層  
10: 電解質被覆層  
11: 電解質被覆層

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2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to a nonaqueous rechargeable battery.

[0002]

[Description of the Prior Art] It consists of a positive electrode, a negative electrode, and nonaqueous electrolyte, and research is actively done as a power source of a noncommercial cellular phone, a portable device, a Personal Digital Assistant, etc. from an usable nonaqueous rechargeable battery having a high energy density compared with water-solution system rechargeable batteries, such as a lead accumulator and a nickel-cadmium battery, repeatedly by charge.

[0003] Research is actively done from the lithium ion battery which consists of the positive electrode containing the positive active material which can carry out an electrochemical reaction reversibly with a lithium ion among said nonaqueous rechargeable batteries, a negative electrode which contains reversibly occlusion and the negative-electrode active material which may be emitted for a lithium ion, and nonaqueous electrolyte containing lithium salt being equipped with the high voltage, a high energy consistency, the outstanding cycle life, high safety, etc.

[0004] Generally as said nonaqueous electrolyte, what dissolved supporting electrolytes, such as  $\text{LiPF}_6$  and  $\text{LiBF}_4$ , in the mixed solvent of high dielectric constant solvents, such as ethylene carbonate and propylene carbonate, and hypoviscosity solvents, such as dimethyl carbonate and diethyl carbonate, is used.

[0005] The outstanding elevated-temperature neglect property is searched for in said nonaqueous rechargeable battery. Said nonaqueous rechargeable battery with which this is used for the cellular phone left at the daytime of midsummer in the automatic in the train ones by which outdoor parking was carried out is because it may be exposed to the hot environments which deviated from the anticipated-use environment.

[0006] However, when said nonaqueous electrolyte was the above configurations and elevated-temperature neglect of the cell of a charge condition was carried out, there was a trouble that an elevated-temperature preservation property fell -- a cell blisters or discharge capacity falls.

[0007] Since the cell was left under hot environments, it is considered to be because for a gas to occur [ that the vapor pressure of the electrolytic solution rose, and ] when the electrolytic solution decomposes on an electrode that a cell blisters as mentioned above. Among these, about generating of the gas on an electrode, it is the causes with main generating of methane [ in / the case of the solvent of the two-component system of EC and EMC / at 70 degrees C or less / a negative electrode ] etc., and our old examination shows that generating of the carbon dioxide gas in a positive electrode becomes the main causes, for example, so that temperature becomes high exceeding 70 degrees C.

[0008] Moreover, it is thought that it is based on the inter-electrode clearance increase resulting from the decomposition reaction of the electrolytic solution on a positive electrode and a negative electrode, the rise of reaction resistance of an electrode, decline in the conductivity of the electrolytic solution, the blinding of a separator, and bulging of a cell etc. that discharge capacity falls as mentioned above.

[0009] The fall of said elevated-temperature neglect properties, such as bulging of a cell and reduction of residual discharge capacity, is so intense that neglect time amount is so long that neglect temperature is high.

[0010]

[Problem(s) to be Solved by the Invention] This invention is completed based on the above situations, and it aims at offering the nonaqueous rechargeable battery equipped with the outstanding elevated-temperature neglect property.

[0011]

[The means for solving a technical problem, and an operation and effectiveness] As a means for attaining the above-mentioned purpose, invention of claim 1 is characterized by the thing which is chosen from the alkylbenzene derivative which has the third class carbon with which said nonaqueous electrolyte is chosen from a sultone compound, an annular sulfate, and vinylene carbonate, and which adjoins a phenyl group with a kind, a cycloalkyl benzene derivative, and a biphenyl derivative and which contain a kind at least in the nonaqueous rechargeable battery which consists of a positive electrode, a negative electrode, and nonaqueous electrolyte.

[0012] The elevated-temperature neglect property in 70 degrees C or less improves by [ which contain a kind at least ] choosing nonaqueous electrolyte from a sultone compound, an annular sulfate, and vinylene carbonate. This is considered to be based on the following reasons. If the above-mentioned compound is contained in the electrolytic solution, when said compound decomposes on a negative electrode, a coat will be formed on a negative electrode. Generating of the methane which originates in disassembly of the electrolytic solution on a negative electrode and disassembly of the electrolytic solution partially disassembled on the positive electrode with the coat concerned can be controlled.

[0013] On the other hand, the elevated-temperature neglect property in the temperature region where nonaqueous electrolyte exceeds 70 degrees C by [ which contain a kind at least ] being chosen out of the alkylbenzene derivative which has the third class carbon which adjoins a phenyl group, a cycloalkyl benzene derivative, and a biphenyl derivative improves. This is considered to be based on the following reasons. If the above-mentioned compound is contained in the electrolytic solution, a coat will be formed for said compound on a positive electrode decomposition and by carrying out a polymerization on a positive electrode. Generating of the carbon dioxide gas which originates in disassembly of the electrolytic solution on a positive electrode and disassembly of the electrolytic solution partially disassembled on the negative electrode with the coat concerned can be controlled.

[0014] And compared with the case where the above-mentioned compound is independently used, respectively by [ which contain a kind at least ] being chosen out of the alkylbenzene derivative which has the third class carbon with which nonaqueous electrolyte is chosen from a sultone compound, an annular sulfate, and vinylene carbonate, and which adjoins a phenyl group with a kind, a cycloalkyl benzene derivative, and a biphenyl derivative, an elevated-temperature neglect property improves at least. This is considered to be based on the following reasons.

[0015] When not using the above-mentioned compound at all, on the electrode set under hot environments, disassembly of the electrolytic solution advances and gas [ , such as carbon dioxide gas, ], such as methane, occurs with the temperature. At this time, not only the electrolytic solution but the electrolytic solution partially disassembled on the electrode of another side is considered to both be decomposed on an electrode.

[0016] Namely, when a coat is formed on a negative electrode in a temperature field 70 degrees C or less and the generation of gas on a negative electrode is controlled, it also sets. [ when it becomes the cause of generating carbon dioxide gas etc. when the electrolytic solution partially disassembled with the negative electrode decomposes with a positive electrode, a coat is formed on a positive electrode in the temperature field exceeding 70 degrees C and the generation of gas on a positive electrode is controlled ] When the electrolytic solution partially disassembled with the positive electrode decomposes with a negative electrode, it becomes the cause of generating methane etc.

[0017] And nonaqueous electrolyte can control at least disassembly of the electrolytic solution in the electrode with which the coat was formed by [ which contain a kind at least ] being chosen out of the

alkylbenzene derivative which has the third class carbon which is chosen from a sultone compound, an annular sulfate, and vinylene carbonate, and which adjoins a phenyl group with a kind, a cycloalkyl benzene derivative, and a biphenyl derivative. It can also control that the electrolytic solution which did not come to accept it but was disassembled partially is disassembled further on the other poles.

Consequently, compared with the case which contained only a kind at least where it is chosen out of a sultone compound, an annular sulfate, and vinylene carbonate, and the case which contained only a kind at least where it is chosen out of the alkylbenzene derivative which has the third class carbon which adjoins a phenyl group, a cycloalkyl benzene derivative, and a biphenyl derivative, more than it added both engine performance, an elevated-temperature neglect property improves.

[0018] The addition of the compound chosen from a sultone compound, an annular sulfate, and vinylene carbonate has 5 or less desirable % of the weight 0.1 % of the weight or more to the total amount of electrolytic solutions, in order to control disassembly of the electrolytic solution effectively, without reducing the initial discharge capacity on the negative electrode under hot environments. Especially, 2 or less % of the weight 0.5 % of the weight or more is desirable.

[0019] The addition of the compound chosen from the alkylbenzene derivative which has the third class carbon which adjoins a phenyl group, a cycloalkyl benzene derivative, and a biphenyl derivative has 4 or less desirable % of the weight 2 % of the weight or more to the total amount of electrolytic solutions, in order to control effectively disassembly of the electrolytic solution on the positive electrode under hot environments.

[0020] Invention of claim 2 is characterized by said sultone compound being a propane sultone, a propene sultone, or a butane sultone in a thing according to claim 1.

[0021] Since the coat stabilized on the negative electrode by using the above-mentioned matter as said sultone compound can be formed, an elevated-temperature neglect property improves.

[0022] Invention of claim 3 is characterized by said annular sulfate being glycol sulfate or propylene glycol sulfate in a thing according to claim 1 or 2.

[0023] Since the coat stabilized on the negative electrode by using the above-mentioned matter as said annular sulfate can be formed, an elevated-temperature neglect property improves.

[0024] Invention of claim 4 is characterized by the alkylbenzene derivative which has the third class carbon which adjoins said phenyl group being either of cumene, 1, 3-diisopropylbenzene, 1, 4-diisopropylbenzene, 1-methylpropyl benzene, 1, 3-bis(1-methylpropyl) benzene, 1, and 4-bis(1-methylpropyl) benzene in a thing according to claim 1 to 3.

[0025] Since the coat stabilized on the positive electrode by using the above-mentioned matter can be formed as an alkylbenzene derivative which has the third class carbon which adjoins said phenyl group, an elevated-temperature neglect property improves.

[0026] Invention of claim 5 is characterized by said cycloalkyl benzene derivative being cyclohexylbenzene or cyclopentyl benzene in a thing according to claim 1 to 4.

[0027] Since the coat stabilized on the positive electrode by using the above-mentioned matter as said cycloalkyl benzene derivative can be formed, an elevated-temperature neglect property improves.

[0028] Invention of claim 6 is characterized by said biphenyl derivative being a biphenyl, 2-fluoro biphenyl, 2-BUROMO biphenyl, or 2-chloro biphenyl in a thing according to claim 1 to 5.

[0029] Since the coat stabilized on the positive electrode by using the above-mentioned matter as said biphenyl derivative is formed, an elevated-temperature neglect property improves.

[0030]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained based on an accompanying drawing. Drawing 1 is the outline sectional view of the square shape nonaqueous rechargeable battery which is 1 operation gestalt of this invention. the positive-electrode charge collector with which this square shape nonaqueous rechargeable battery 1 consists of aluminium foil -- a positive electrode -- it is a thing with a negative-electrode width-of-face [ which comes to contain the flat volume-like electrode group 2 around which the negative electrode 4 which comes to apply a mixture was wound through the separator 5, and nonaqueous electrolyte in the cell case 6 / of 30mm ] x height [ of 48mm ] x thickness of 4mm at the negative-electrode charge collector which serves as the positive

electrode 3 which comes to apply a mixture from copper foil.

[0031] The cell lid 7 which formed the relief valve 8 is attached in the cell case 6 by laser welding, the negative-electrode terminal 9 is connected with a negative electrode 4 through the negative-electrode lead 11, and the positive electrode 3 is connected with the cell lid through the positive-electrode lead 10.

[0032] As a non-aqueous solvent of the nonaqueous electrolyte concerning this invention For example, annular carbonate, such as ethylene carbonate, propylene carbonate, and butylene carbonate Chain-like carbonate, such as dimethyl carbonate, diethyl carbonate, and ethyl methyl carbonate Cyclic ester, such as gamma-butyrolactone and gamma-valerolactone, methyl acetate, Chain-like ester, such as methyl propionate, a tetrahydrofuran, 2-methyl tetrahydrofuran, Chain-like ether, such as cyclic ether, such as tetrahydropyran, dimethoxyethane, and dimethoxymethane, Chain-like phosphoric ester, such as cyclic-phosphoric-acid ester, such as phosphoric-acid ethylene methyl and phosphoric-acid ethyl ethylene, trimethyl phosphate, and phosphoric-acid triethyl, the halogenide of these compounds, etc. can be used. Only one kind may be chosen and used for these organic solvents, and may be used for them combining two or more kinds.

[0033] As a solute of the nonaqueous electrolyte concerning this invention, the inorganic lithium salt of  $\text{LiClO}_4$ ,  $\text{LiPF}_6$ , and  $\text{LiBF}_4$  grade, the fluorine-containing organic lithium salt of  $\text{LiCF}_3\text{SO}_3$ ,  $\text{LiN}(\text{CF}_3\text{SO}_2)_2$  and  $\text{LiN}(\text{CF}_3\text{CF}_2\text{SO}_2)_2$ ,  $\text{LiN}(\text{CF}_3\text{CO})_2$ , and  $\text{LiC}(\text{CF}_3\text{SO}_2)_3$  grade, etc. can be mentioned. Only one kind may be chosen and used for these solutes, and may be used for them combining two or more kinds.

[0034] As a sultone compound added to the nonaqueous electrolyte concerning this invention, it can choose from a propane sultone, a propene sultone, or a butane sultone, and can use.

[0035] As an annular sulfate added to the electrolytic solution concerning this invention, it can choose from glycol sulfate or propylene glycol sulfate, and can use.

[0036] Vinylene carbonate can be added to the nonaqueous electrolyte concerning this invention. As an alkylbenzene derivative which has the third class carbon which adjoins the phenyl group added to nonaqueous electrolyte, either which is chosen from cumene, 1, 3-diisopropylbenzene, 1, 4-diisopropylbenzene, 1-methylpropyl benzene, 1, 3-bis(1-methylpropyl) benzene, 1, and 4-bis(1-methylpropyl) benzene can be used.

[0037] As a cycloalkyl benzene derivative added to the nonaqueous electrolyte concerning this invention, either which is chosen from cyclohexylbenzene and cyclopentyl benzene can be used.

[0038] As a biphenyl derivative added to the nonaqueous electrolyte concerning this invention, either which is chosen from a biphenyl, 2-fluoro biphenyl, 2-BUROMO biphenyl, and 2-chloro biphenyl can be used. 2-fluoro biphenyl, 2-BUROMO biphenyl, and 2-chloro biphenyl are more desirable, and especially 2-fluoro biphenyl is [ among these ] still more desirable.

[0039] As a separator, nonwoven fabrics, such as macromolecule porosity film and nonwoven fabrics, such as polyethylene, polypropylene, and polyester, and a glass fiber, the nonwoven fabric of a glass fiber and macromolecule fiber, etc. can be used.

[0040] As positive active material, the lithium transition-metals multiple oxide expressed with a general formula  $\text{LiMO}_2$  (M is transition metals) and the lithium manganese multiple oxide which has Spinel structure which has stratified rock salt structure can be used. Moreover, the metal chalcogen ghost which does not contain lithiums, such as  $\text{TiO}_2$ ,  $\text{TiS}_2$ ,  $\text{V}_2\text{O}_5$ , and  $\text{MnO}_2$ ,  $\text{MoO}_3$ , can be used. However, when using said metal chalcogen ghost, what full discharge of such positive active material is carried out beforehand, or is considered as the condition of having discharged partially and having doped the lithium ion is desirable.

[0041] Especially the class of electric conduction agent may not be restricted, may be a metal, or may be nonmetallic. As a metaled electric conduction agent, the ingredient which consists of metallic elements, such as Cu and nickel, can be mentioned. Moreover, as an electric conduction agent of a nonmetal, carbon materials, such as graphite, carbon black, acetylene black, and KETCHIEN black, can be mentioned.

[0042] If a binder is a stable ingredient to the solvent and the electrolytic solution which are used at the

time of electrode manufacture, especially the class will not be restricted. Specifically Polyethylene, polypropylene, polyethylene terephthalate, Resin system giant molecules, such as aromatic polyamide and a cellulose, a styrene butadiene rubber, Rubber-like macromolecules, such as polyisoprene rubber, butadiene rubber, and ethylene-propylene rubber, A styrene-butadiene-styrene block copolymer and its hydrogenation object, A styrene-ethylene-butadiene-styrene block copolymer and its hydrogenation object, Thermoplastic-elastomer-like macromolecules, such as a styrene-isoprene-styrene block copolymer and its hydrogenation object, Syndiotactic 1, 2-polybutadiene, an ethylene-vinylacetate copolymer, Fluorine system giant molecules, such as an elasticity resin-like giant-molecules [, such as a propylene-alpha olefin (carbon numbers 2-12) copolymer ], polyvinylidene fluoride, polytetrafluoroethylene, and polytetrafluoroethylene-ethylene copolymer, etc. can be used.

[0043] Moreover, the macromolecule constituent which has alkali-metal ion conductivity, such as a lithium ion, especially as a binder can also be used. As a macromolecule which has such ion conductivity Polyether system high molecular compounds, such as polyethylene oxide and polypropylene oxide, The crosslinked polymer compound of a polyether, polyepichlorohydrin, poly FOSUFAZEN, A polysiloxane, a polyvinyl pyrrolidone, poly vinylidene carbonate, The system which compounded the alkali-metal salt which makes lithium salt or a lithium a subject with high molecular compounds, such as a polyacrylonitrile, Or the system which blended with this the organic compound which has high dielectric constants, such as propylene carbonate, ethylene carbonate, and gamma-butyrolactone, can be used. These ingredients may be combined and used.

[0044] In a positive-electrode charge collector, aluminum, Ta, Nb, Ti, Hf, Zr, Zn, W, Bi, the alloy containing these metals, etc. can be illustrated. These metals form a passive state coat in a front face by anodic oxidation in the electrolytic solution. Therefore, it can prevent effectively that nonaqueous electrolyte carries out oxidative degradation in a part for the wetted part of a positive-electrode charge collector and the electrolytic solution. Consequently, the cycle property of a nonaqueous rechargeable battery can be raised effectively. The alloy which contains aluminum, Ti, Ta, and these metals among the above-mentioned metals can be used suitably. Since especially aluminum and its alloy are a low consistency, they can make mass of a positive-electrode charge collector small compared with the case where other metals are used. Therefore, since the energy density of a cell can be raised, it is especially desirable.

[0045] the positive electrode obtained as mentioned above -- when applying a mixture to a positive-electrode charge collector, a well-known means can perform. When mixture is a slurry-like, it can apply on a charge collector using a doctor blade etc. Moreover, when mixture is a paste-like, it can apply on a charge collector by roller coating etc. When the solvent is being used, an electrode can be produced by drying and removing a solvent.

[0046] As a negative-electrode active material, transition-metals oxides, such as carbon materials, such as lithium nitrides, such as lithium alloys, such as a lithium metal, a lithium-aluminium alloy which can emit [ \*\*\*\* and ] a lithium and which is the matter, a lithium-lead alloy, and a lithium-tin alloy, and Li<sub>5</sub> (Li<sub>3</sub>N), a graphite, corks, and an organic substance baking object, and WO<sub>2</sub>, MoO<sub>2</sub>, SnO<sub>2</sub>, SnO, TiO<sub>2</sub>, NbO<sub>3</sub>, can be used. Only one kind may be chosen and used for these negative-electrode active materials, and may be used for them combining two or more kinds.

[0047] It is desirable that they are metals, such as copper, nickel, and stainless steel, and in these, it is easy to process it into a thin film, and since the quality of the material of a negative-electrode charge collector is cheap, although copper foil is used for it, it is more desirable.

[0048] Especially the manufacture approach of a negative electrode is not restricted, but can be manufactured by the manufacture approach of the above-mentioned positive electrode, and the same approach.

[0049] Hereafter, this invention is explained to a detail based on an example. In addition, this invention is not limited at all by the following example.

[0050] the positive electrode with which a <example 1> positive-electrode plate comes to mix the polyvinylidene fluoride 8 weight section which is a binder, the acetylene black 5 weight section which is an electric conduction agent, and the lithium cobalt multiple oxide 87 weight section which is positive



active material -- after adding N-methyl pyrrolidone to the mixture suitably and preparing in the shape of a paste, it manufactured by applying this to both sides of an aluminium foil charge collector with a thickness of 20 micrometers, and drying.

[0051] the negative electrode with which a negative-electrode plate comes to mix 95 % of the weight (graphite) of graphite, and 2 % of the weight of carboxymethyl celluloses and 3 % of the weight of styrene butadiene rubber -- after adding water suitably and preparing it in the shape of a paste to a mixture, it manufactured by applying this on a copper foil charge collector with a thickness of 15 micrometers, and drying.

[0052] The fine porosity film made from polyethylene was used for the separator. Moreover, 1 mol/l dissolution of LiPF<sub>6</sub> was carried out, and 0.5 % of the weight of propane sultones and the thing which added 3 % of the weight of cyclohexylbenzenes were used for the mixed solvent which mixed ethylene carbonate and ethyl methyl carbonate at a rate of 3:7 by the volume ratio to the electrolytic solution to the total amount of electrolytic solutions.

[0053] Twelve cels of nonaqueous rechargeable batteries with a width-of-face [ of 30mm ] x height [ of 48mm ] x thickness of 4mm were produced using the above-mentioned component.

[0054] About an example 2 thru/or 66 and the example 1 of a comparison the <13> example 2 thru/or the nonaqueous rechargeable battery of 18, 12 every cels each of nonaqueous rechargeable batteries were produced like the example 1 except having added the matter which replaced with a propane sultone and cyclohexylbenzene and was shown in Table 1 as matter added to the electrolytic solution.

[0055] About the nonaqueous rechargeable battery of an example 19 thru/or an example 30, 12 every cels each of nonaqueous rechargeable batteries were produced like the example 1 except having added the matter which replaced with a propane sultone and cyclohexylbenzene and was shown in Table 2 as matter added to the electrolytic solution.

[0056] About the nonaqueous rechargeable battery of an example 31 thru/or an example 48, 12 every cels each of nonaqueous rechargeable batteries were produced like the example 1 except having added the matter which replaced with a propane sultone and cyclohexylbenzene and was shown in Table 3 as matter added to the electrolytic solution.

[0057] About the nonaqueous rechargeable battery of an example 49 thru/or an example 66, 12 every cels each of nonaqueous rechargeable batteries were produced like the example 1 except having added the matter which replaced with a propane sultone and cyclohexylbenzene and was shown in Table 4 as matter added to the electrolytic solution.

[0058] About the nonaqueous rechargeable battery of the example 1 of a comparison thru/or the example 17 of a comparison, 12 every cels each of nonaqueous rechargeable batteries were produced like the example 1 except having added the matter which replaced with a propane sultone and cyclohexylbenzene and was shown in Table 5 as matter added to the electrolytic solution.

[0059] About the <measurement> (discharge capacity) example 1 thru/or 66 and the example 1 of a comparison thru/or the nonaqueous rechargeable battery of 17, after charging in 25 degrees C for 3 hours by 600mA of charging currents, and the constant current-constant-potential charge of charge electrical-potential-difference 4.20V, the discharge capacity when discharging on condition that 600mA of discharge currents and termination electrical-potential-difference 2.75V was measured, and this was made into initial discharge capacity.

[0060] (Elevated-temperature shelf test) In 25 degrees C, it charged for 3 hours by 600mA of charging currents, and the constant current-constant-potential charge of charge electrical-potential-difference 4.20V about an example 1 thru/or 66 and the example 1 of a comparison thru/or the nonaqueous rechargeable battery of 17. Thus, cell thickness was measured after leaving the cell changed into the charge condition at 100 degrees C for 48 hours. Moreover, after leaving the cell changed into said charge condition for 30 days at 60 degrees C, cell thickness and discharge capacity were measured.

[0061] After said 60-degree-C neglect, once discharging, measured discharge capacity which carried out charge and discharge again was \*(ed) by said initial discharge capacity, and the capacity retention after 60-degree-C neglect (%) was computed by multiplying this by 100.

[0062] The above-mentioned measurement result was summarized in Table 1 thru/or 5.



[0063]

[Table 1]

電池	添加剤1		添加剤2		100℃×48時間 放置後	60℃×30日 放置後	
	物質名	添加量 (wt%)	物質名	添加量 (wt%)	電池厚み (mm)	電池厚み (mm)	容量保持率 (%)
実施例 1	シクロヘキシルベンゼン	3	1, 3-プロパンスルトン	0.5	8.8	4.9	91
実施例 2	シクロヘキシルベンゼン	3	1, 4-ブタンスルトン	0.5	9.0	4.9	89
実施例 3	シクロヘキシルベンゼン	3	1, 3-プロベンスルトン	0.5	8.8	4.7	91
実施例 4	シクロヘキシルベンゼン	3	グリコールサルフェート	0.5	8.9	4.9	90
実施例 5	シクロヘキシルベンゼン	3	プロピレングリコールサルフェート	0.5	9.0	4.9	90
実施例 6	シクロヘキシルベンゼン	3	ピニレンカーボネート	0.5	9.1	4.8	90
実施例 7	シクロヘキシルベンゼン	3	1, 3-プロパンスルトン	1	8.5	4.7	98
実施例 8	シクロヘキシルベンゼン	3	1, 4-ブタンスルトン	1	8.8	4.8	93
実施例 9	シクロヘキシルベンゼン	3	1, 3-プロベンスルトン	1	8.4	4.8	97
実施例 10	シクロヘキシルベンゼン	3	グリコールサルフェート	1	8.6	4.8	94
実施例 11	シクロヘキシルベンゼン	3	プロピレングリコールサルフェート	1	8.6	4.8	94
実施例 12	シクロヘキシルベンゼン	3	ピニレンカーボネート	1	9.1	4.8	93
実施例 13	シクロペンチルベンゼン	3	1, 3-プロパンスルトン	1	8.6	4.8	96
実施例 14	シクロペンチルベンゼン	3	1, 4-ブタンスルトン	1	8.8	4.8	94
実施例 15	シクロペンチルベンゼン	3	1, 3-プロベンスルトン	1	8.6	4.8	97
実施例 16	シクロペンチルベンゼン	3	グリコールサルフェート	1	8.6	4.8	95
実施例 17	シクロペンチルベンゼン	3	プロピレングリコールサルフェート	1	8.5	4.7	94
実施例 18	シクロペンチルベンゼン	3	ピニレンカーボネート	1	8.9	4.7	93

[0064]

[Table 2]

電池	添加剤1		添加剤2		100℃×48時間 放置後	60℃×30日 放置後	
	物質名	添加量 (wt%)	物質名	添加量 (wt%)	電池厚み (mm)	電池厚み (mm)	容量保持率 (%)
実施例 19	ビフェニル	3	1, 3-プロパンスルトン	1	9.3	4.9	93
実施例 20	ビフェニル	3	1, 4-ブタンスルトン	1	9.5	5.0	92
実施例 21	ビフェニル	3	1, 3-プロベンスルトン	1	9.3	4.8	94
実施例 22	ビフェニル	3	グリコールサルフェート	1	9.7	5.0	93
実施例 23	ビフェニル	3	プロピレングリコールサルフェート	1	9.7	4.9	93
実施例 24	ビフェニル	3	ピニレンカーボネート	1	9.8	4.8	92
実施例 25	2-フルオロビフェニル	3	1, 3-プロパンスルトン	1	8.8	4.8	97
実施例 26	2-フルオロビフェニル	3	1, 4-ブタンスルトン	1	8.8	4.7	95
実施例 27	2-フルオロビフェニル	3	1, 3-プロベンスルトン	1	8.8	4.5	97
実施例 28	2-フルオロビフェニル	3	グリコールサルフェート	1	8.8	4.8	96
実施例 29	2-フルオロビフェニル	3	プロピレングリコールサルフェート	1	8.8	4.7	98
実施例 30	2-フルオロビフェニル	3	ピニレンカーボネート	1	9.0	4.5	95

[0065]

[Table 3]

電池	添加剤1		添加剤2		100℃×48時間 放置後	60℃×30日 放置後	
	物質名	添加量 (wt%)	物質名	添加量 (wt%)	電池厚み (mm)	電池厚み (mm)	容量保持率 (%)
実施例 31	クメン	3	1, 3-プロパンスルトン	1	8.9	4.8	96
実施例 32	クメン	3	1, 4-ブタンスルトン	1	9.0	4.9	94
実施例 33	クメン	3	1, 3-プロベンスルトン	1	8.8	4.8	96
実施例 34	クメン	3	グリコールサルフェート	1	9.1	4.9	96
実施例 35	クメン	3	プロピレングリコールサルフェート	1	9.0	4.8	95
実施例 36	クメン	3	ピニレンカーボネート	1	9.2	4.7	94
実施例 37	1, 3-ジイソプロピルベンゼン	3	1, 3-プロパンスルトン	1	9.1	4.8	96
実施例 38	1, 3-ジイソプロピルベンゼン	3	1, 4-ブタンスルトン	1	9.1	4.9	94
実施例 39	1, 3-ジイソプロピルベンゼン	3	1, 3-プロベンスルトン	1	9.0	4.8	96
実施例 40	1, 3-ジイソプロピルベンゼン	3	グリコールサルフェート	1	9.3	4.9	95
実施例 41	1, 3-ジイソプロピルベンゼン	3	プロピレングリコールサルフェート	1	9.3	4.9	95
実施例 42	1, 3-ジイソプロピルベンゼン	3	ピニレンカーボネート	1	9.3	4.8	94
実施例 43	1, 4-ジイソプロピルベンゼン	3	1, 3-プロパンスルトン	1	9.1	4.8	96
実施例 44	1, 4-ジイソプロピルベンゼン	3	1, 4-ブタンスルトン	1	9.2	4.8	95
実施例 45	1, 4-ジイソプロピルベンゼン	3	1, 3-プロベンスルトン	1	9.0	4.8	96
実施例 46	1, 4-ジイソプロピルベンゼン	3	グリコールサルフェート	1	9.5	4.9	96
実施例 47	1, 4-ジイソプロピルベンゼン	3	プロピレングリコールサルフェート	1	9.4	4.8	95
実施例 48	1, 4-ジイソプロピルベンゼン	3	ピニレンカーボネート	1	9.8	4.7	94

[0066]

[Table 4]

電池	添加剤1		添加剤2		100℃×48時間 放置後	80℃×30日 放置後	
	物質名	添加量 (wt%)	物質名	添加量 (wt%)	電池厚み (mm)	電池厚み (mm)	容量保持率 (%)
実施例49	1-メチルプロピルベンゼン	3	1,3-プロパンスルホン	1	8.9	4.9	96
実施例50	1-メチルプロピルベンゼン	3	1,4-ブタンスルホン	1	9.0	4.9	95
実施例51	1-メチルプロピルベンゼン	3	1,3-プロペンスルホン	1	8.8	4.8	96
実施例52	1-メチルプロピルベンゼン	3	グリコールサルフェート	1	9.1	4.9	96
実施例53	1-メチルプロピルベンゼン	3	プロピレングリコールサルフェート	1	9.1	4.7	96
実施例54	1-メチルプロピルベンゼン	3	ピニレンカーボネート	1	9.2	4.8	95
実施例55	1,3-ビス(1-メチルプロピル)ベンゼン	3	1,3-プロパンスルホン	1	9.1	4.8	96
実施例56	1,3-ビス(1-メチルプロピル)ベンゼン	3	1,4-ブタンスルホン	1	9.3	4.9	95
実施例57	1,3-ビス(1-メチルプロピル)ベンゼン	3	1,3-プロペンスルホン	1	9.0	4.8	96
実施例58	1,3-ビス(1-メチルプロピル)ベンゼン	3	グリコールサルフェート	1	9.5	4.9	96
実施例59	1,3-ビス(1-メチルプロピル)ベンゼン	3	プロピレングリコールサルフェート	1	9.6	4.9	95
実施例60	1,3-ビス(1-メチルプロピル)ベンゼン	3	ピニレンカーボネート	1	9.7	4.9	96
実施例61	1,4-ビス(1-メチルプロピル)ベンゼン	3	1,3-プロパンスルホン	1	9.2	4.8	95
実施例62	1,4-ビス(1-メチルプロピル)ベンゼン	3	1,4-ブタンスルホン	1	9.1	4.9	94
実施例63	1,4-ビス(1-メチルプロピル)ベンゼン	3	1,3-プロペンスルホン	1	9.0	4.8	95
実施例64	1,4-ビス(1-メチルプロピル)ベンゼン	3	グリコールサルフェート	1	9.5	4.9	95
実施例65	1,4-ビス(1-メチルプロピル)ベンゼン	3	プロピレングリコールサルフェート	1	9.5	4.9	95
実施例66	1,4-ビス(1-メチルプロピル)ベンゼン	3	ピニレンカーボネート	1	9.5	4.8	94

[0067]

[Table 5]

電池	添加剤1		添加剤2		100℃×48時間 放置後	80℃×30日 放置後	
	物質名	添加量 (wt%)	物質名	添加量 (wt%)	電池厚み (mm)	電池厚み (mm)	容量保持率 (%)
比較例 1	なし	3	なし	—	13.1	8.5	73
比較例 2	シクロヘキシルベンゼン	3	なし	—	10.3	6.2	76
比較例 3	シクロペンチルベンゼン	3	なし	—	10.4	6.2	77
比較例 4	ビフェニル	3	なし	—	10.3	6.3	76
比較例 8	2-フルオロビフェニル	3	なし	—	10.4	6.1	78
比較例 6	クメン	3	なし	—	10.6	6.2	77
比較例 7	1,3-ジイソプロピルベンゼン	3	なし	—	10.9	6.3	76
比較例 8	1,4-ジイソプロピルベンゼン	3	なし	—	11.0	6.2	76
比較例 9	1-メチルプロピルベンゼン	3	なし	—	10.8	6.3	76
比較例 10	1,3-ビス(1-メチルプロピル)ベンゼン	3	なし	—	10.9	6.3	77
比較例 11	1,4-ビス(1-メチルプロピル)ベンゼン	3	なし	—	10.9	6.3	76
比較例 12	なし	—	1,3-プロパンスルホン	1	12.5	5.3	85
比較例 13	なし	—	1,4-ブタンスルホン	1	12.6	5.4	81
比較例 14	なし	—	1,3-プロペンスルホン	1	12.3	5.3	87
比較例 15	なし	—	グリコールサルフェート	1	12.8	5.6	84
比較例 16	なし	—	プロピレングリコールサルフェート	1	12.8	5.6	84
比較例 17	なし	—	ピニレンカーボネート	1	12.7	5.5	82

[0068] When the <result> (100-degree C cell bulging) example 1 thru/or 66 were compared with the example 1 of a comparison, in the example 1 of a comparison, it was remarkably [ to cell bulging having been 5.8mm or less / as 9.1mm ] large at an example 1 thru/or 66. This is considered to be because for the cell to have blistered for the gas which occurred by disassembly of the electrolytic solution as a result of not forming a coat good on a positive electrode and a negative electrode, when the example 1 of a comparison does not contain at all the alkylbenzene derivative which has the third class carbon which adjoins a sultone compound, an annular sulfate, vinylene carbonate, and a phenyl group, a cycloalkyl benzene derivative, and a biphenyl derivative.

[0069] Compared with 6.3mm or more, and an example 1 thru/or 66, when an example 1 thru/or 66 were compared with the example 2 of a comparison thru/or 11, cell bulging was large at the example 2 of a comparison thru/or 11. This is considered to be based on the following reasons. In the example 2 of a comparison which does not contain a sultone compound, an annular sulfate, and vinylene carbonate thru/or 11, a good coat is not formed on a negative electrode. For this reason, generating of the methane on a negative electrode etc. cannot be controlled at the time of an elevated temperature. Therefore, also in 100 degrees C, bulging of a cell becomes large with the methane generated on a negative electrode.

[0070] Moreover, also in the example 2 of a comparison thru/or 11, since the coat is formed on the positive electrode like an example 1 thru/or 66, carbon-dioxide-gas generating from the positive electrode which is the cause of main of cell bulging is considered to be controlled. However, although it does not result in generating of carbon dioxide gas on the positive electrode covered with the coat, it is thought that the partial decomposition reaction of the electrolytic solution is advancing. It is thought that the matter with which some electrolytic solutions were disassembled generates by such decomposition

reaction. Thus, it is thought that the matter with which some electrolytic solutions were disassembled decomposes further on a negative electrode, and generates methane etc. In an example 1 thru/or 66, since the coat is formed also on the negative electrode, the above reactions are also controlled.

[0071] Compared with 8.3mm or more, and an example 1 thru/or 66, when an example 1 thru/or 66 were compared with the example 12 of a comparison thru/or 17, cell bulging was large at the example 12 of a comparison thru/or 17. This is considered to be based on the following reasons. In the example 12 of a comparison which does not contain the alkylbenzene derivative which has the third class carbon which adjoins a phenyl group, a cycloalkyl benzene derivative, and a biphenyl derivative thru/or 17, a good coat is not formed on a positive electrode. For this reason, generating of the carbon dioxide gas on a positive electrode cannot be controlled at the time of an elevated temperature. Therefore, in 100-degree-C neglect, a cell will blister with the carbon dioxide gas which occurs on a positive electrode.

[0072] Moreover, also in the example 12 of a comparison thru/or 17, since the coat is formed on the negative electrode like an example 1 thru/or 66, it is thought that generating of the methane from a negative electrode etc. is controlled. However, although it does not result in generating of methane etc. on the negative electrode covered with the coat, it is thought that the partial decomposition reaction of the electrolytic solution is advancing. It is thought that the matter with which some electrolytic solutions were disassembled generates by such decomposition reaction. Thus, it is thought that the matter with which some electrolytic solutions were disassembled decomposes further on a positive electrode, and generates carbon dioxide gas etc. In an example 1 thru/or 66, since the coat is formed also on the positive electrode, the above reactions are also controlled.

[0073] As shown in Table 1, the above-mentioned result and the same result were obtained also about cell bulging after the long-term neglect in 60 degrees C. Moreover, as the capacity retention after the long-term neglect in 60 degrees C was shown in a mist beam and Table 1, the above-mentioned result and the result of the same inclination were obtained.

[0074] (Conclusion) As mentioned above, it turned out at least that the nonaqueous rechargeable battery equipped with the elevated-temperature neglect property of having excelled by [ which contain a kind at least ] being chosen out of the alkylbenzene derivative which has the third class carbon with which nonaqueous electrolyte is chosen from a sultone compound, an annular sulfate, and vinylene carbonate, and which adjoins a phenyl group with a kind, a cycloalkyl benzene derivative, and a biphenyl derivative can be obtained.

[0075] Within limits which it is not limited to the operation gestalt explained with the above-mentioned description and a drawing, and the following operation gestalten are also included in the technical range of this invention, for example, do not deviate from a summary further besides the following, operation gestalt > this invention besides < can be changed variously, and can be carried out.

[0076] Although the above-mentioned operation gestalt explained as a square shape nonaqueous rechargeable battery 1, especially cell structure is not limited but, of course, it is good also as a cylindrical shape, saccate, a lithium-polymer battery, etc.

[0077]

[Effect of the Invention] According to this invention, the nonaqueous rechargeable battery equipped with the outstanding elevated-temperature neglect property can be obtained.

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[Translation done.]